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**GODDARD SPACE-FLIGHT CENTER**  
**GREENBELT, MARYLAND**


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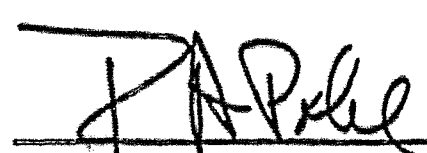
  
\_\_\_\_\_  
Ground Segment Manager (or designated representative)

\_\_\_\_\_  
(Date)

EDC:

  
\_\_\_\_\_  
Chief, EROS Data Center (or designated representative)

  
\_\_\_\_\_  
(Date)

  
\_\_\_\_\_  
Data Production Branch Chief (or designated representative)

  
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(Date)

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- \*\*\* A triple asterisk denotes a page that is deleted from the document.

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## SECTION 1

### SCOPE

#### 1.1 PURPOSE

This document describes the 241 mm photographic product produced by the Goddard Space Flight Center (GSFC) Data Management System (DMS) for Landsat-D.

#### 1.2 APPLICABILITY

This document applies to all TM imagery produced on the Landsat-D DMS high resolution film recorder. The TM requirements for F241-PT are derived from the Goddard Specification, GSFC-430-D-100.

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SECTION 2

APPLICABLE DOCUMENTS

2.1 GOVERNMENT DOCUMENTS

None

2.2 GENERAL ELECTRIC COMPANY DOCUMENTS

a. GES 10066

Goodyear High Resolution Film Recorder to Data Management System (DMS)  
Interface Control Document

b. SVS 9832

Specification for Laser Beam Recorder (LBR)

c. GES 10142

Landsat-D Photoprocessing ICD

2.3 OTHER DOCUMENTS

None



SECTION 3  
PRODUCT DESCRIPTION

3.1 FILM TYPE

Rolls of film shall be a maximum of 250 feet long, 241 mm wide and of 4 mil thickness (Kodak type S0394).

3.2 FILM FORMAT

Each roll of film shall contain fully processed (PT) images. A nominal image describes a 185 km x 170 km section of the globe in a particular spectral band. The images on the film shall be grouped by scenes. A scene consists of seven images of the same section of the globe in seven different spectral bands.

Each roll of film shall contain an end of roll target and a test image at each end of the film. Up to 34 scenes with seven images for each scene shall be recorded on a roll. Each image on the film will be surrounded by tick mark zones on all four sides. An annotation line, gray scale steps, and resolution patterns will be placed at the bottom of the image. Four registration marks will surround the image on the sides. The purpose and formats of each of these fields will be explained later in this section. The roll identification number shall appear in the annotation block of the test image at each end of the roll. Figure 4-1 shows the film format.

3.3 FILM MODE

The imagery shall be in a positive true mode with a linear transmission transfer function. The film density corresponding to image gray level 255 (brightest)

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shall be  $.1 \pm .05$ , and the density corresponding to gray level 0 (darkest) shall be  $2.1 \pm .05$ . Each image shall be surrounded on all four sides by black borders of maximum density level of  $2.1 \pm .05$ . The annotation fields and the registration marks shall be printed clear against the black background.

### 3.4 IMAGE DIMENSIONS

Figure 4-2 shows a symbolic representation of an image on 241 mm film. Figure 4-3 identifies the image dimensions; Table 5-1 lists the values of the dimensions for PT images. The X and Y scales for a PT image shall be 1:1,000,000. The image overlap marks facilitate alignment of consecutive images in a path. These marks appear on the HDT-PT as part of the image data, hence they will automatically appear on the film. The nominal positions of the overlap marks with reference to the image is given in Figure 4-6a. The format of an overlap mark is given in Figure 4-6b.

### 3.5 SPACING BETWEEN IMAGES

Space between images of the same scene shall be  $55 \pm 5$  mm. Space between image 7 of one scene and image 1 of the next scene shall be between 55 mm and 120 mm. If the LBR halts between two scenes, the film shall have a trailer of  $55 \pm 5$  mm of black area before the halt. When the LBR resumes recording, it shall record  $55 \pm 5$  mm of black area before the first image.

### 3.6 ANNOTATION LINE

A 128-character annotation line will contain the alphanumeric description for each image. The format is described in Table 5-2 and an example is shown in Figure 4-7.

### 3.7 FRAME ID

The frame ID is a four-character, right-justified number located to the right of the gray scale field. This will contain the position of the image on the roll. Frame ID number zero shall be given to the first test image; the subsequent images will be identified starting from frame 1.

### 3.8 GRAY SCALE

The gray scale consists of sixteen density steps. The steps represent a linear division of the full scale of radiance values. The input values and their corresponding density levels are listed in Table 5-3.

### 3.9 RESOLUTION PATTERNS

The resolution patterns are located as illustrated in Figure 4-2. There are four spatial frequencies for each of the horizontal and vertical directions. Distinctness with increasing frequency directly indicates the quality of image resolution (reference paragraph 2.2.a). The two density levels used in the pattern are 255 (the lowest) and 0 (the highest). The following list describes the frequency patterns:

#### BLOCK NUMBER

- 1 (vertical)
- 2 (vertical)
- 3 (vertical)
- 4 (vertical)
- 5 (horizontal)
- 6 (horizontal)
- 7 (horizontal)
- 8 (horizontal)

#### FREQUENCY DESCRIPTION (REPEATS)

- 1 pixel high, 1 pixel low, etc.
- 2 pixels high, 2 pixels low, etc.
- 4 pixels high, 4 pixels low, etc.
- 8 pixels high, 8 pixels low, etc.
- 1 line high, 1 line low, etc.
- 2 lines high, 2 lines low etc.
- 4 lines high, 4 lines low, etc.
- 8 lines high, 8 lines low, etc.

A sample resolution pattern is shown below:



Resolution Target Line

### 3.10 REGISTRATION MARKS

Four registration marks appear around the image as illustrated in Figure 4-2. The marks facilitate image alignment when printing color composites. Figure 4-4 (a, b and c) show the registration mark dimensions. The registration marks shall be clear against black background with a black 2 x 2 pixel square at the center of the intersection.

### 3.11 TICK MARK INFORMATION

Tick marks will be provided for PT imagery. Up to eight tick marks may appear on each side of the image, positioned to minimize crowding. Tick marks are provided for one of the following map projections:

- a. Space Oblique Mercator (SOM)
- b. Universal Transverse Mercator (UTM)
- c. Polar Stereographic (PS).

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UTM map projection is provided when the framed image data covers sites from equator up to  $65^{\circ}\text{N}$  latitude or  $65^{\circ}\text{S}$  latitude. For areas north of  $65^{\circ}\text{N}$  latitude or south of  $65^{\circ}\text{S}$  latitude PS map projection is used. For the SOM projection, one tick mark with latitude/longitude coordinates will be inserted in each of the four tick mark borders. They will consist of one pair of latitude and one pair of longitude tick marks giving the latitude and longitude of the image center to the closest  $0.25^{\circ}$ . Figure 4-8 explains tick mark placement around the image. Figure 4-9 gives the tick mark formats for the three map projections.

3.12 END OF ROLL TARGET

There will be an end of roll target exposed photographically by the Photographic Engineering Laboratory at each end of film roll. The targets provide information about the density, uniformity, and resolution of the processing done by the Photographic Engineering Laboratory. The EORT shall be as specified in GES 10142, Landsat-D Photoprocessing ICD. Figure 4-1 illustrates the position of EORT on the film, and Figure 4-10 shows the detail of an EORT square inset. The circles are all black (without detail). EORT characteristics shall be as follows:

Uniformity	< 0.10
Density	Not designated as acceptance measurements for production film rolls

3.13 ROLL IDENTIFICATION

The roll identification number is to be recorded in the annotation block of the test images that shall precede and follow regular imagery. This special annotation line shall be in the format specified in Table 5-4. The components of the test image shall be set to the following:

- a. Tick mark annotation shall be blank, tick marks may appear in any location
- b. Image number field shall be filled with "0000"
- c. Gray scale and resolution target line shall be the same as provided for regular imagery
- d. Image field format shall be as specified in Figure 4-11.

The space between the test image and the first regular image shall be between 55mm and 120mm.

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SECTION 4

ILLUSTRATIONS

This section contains all the figures referenced in this document.

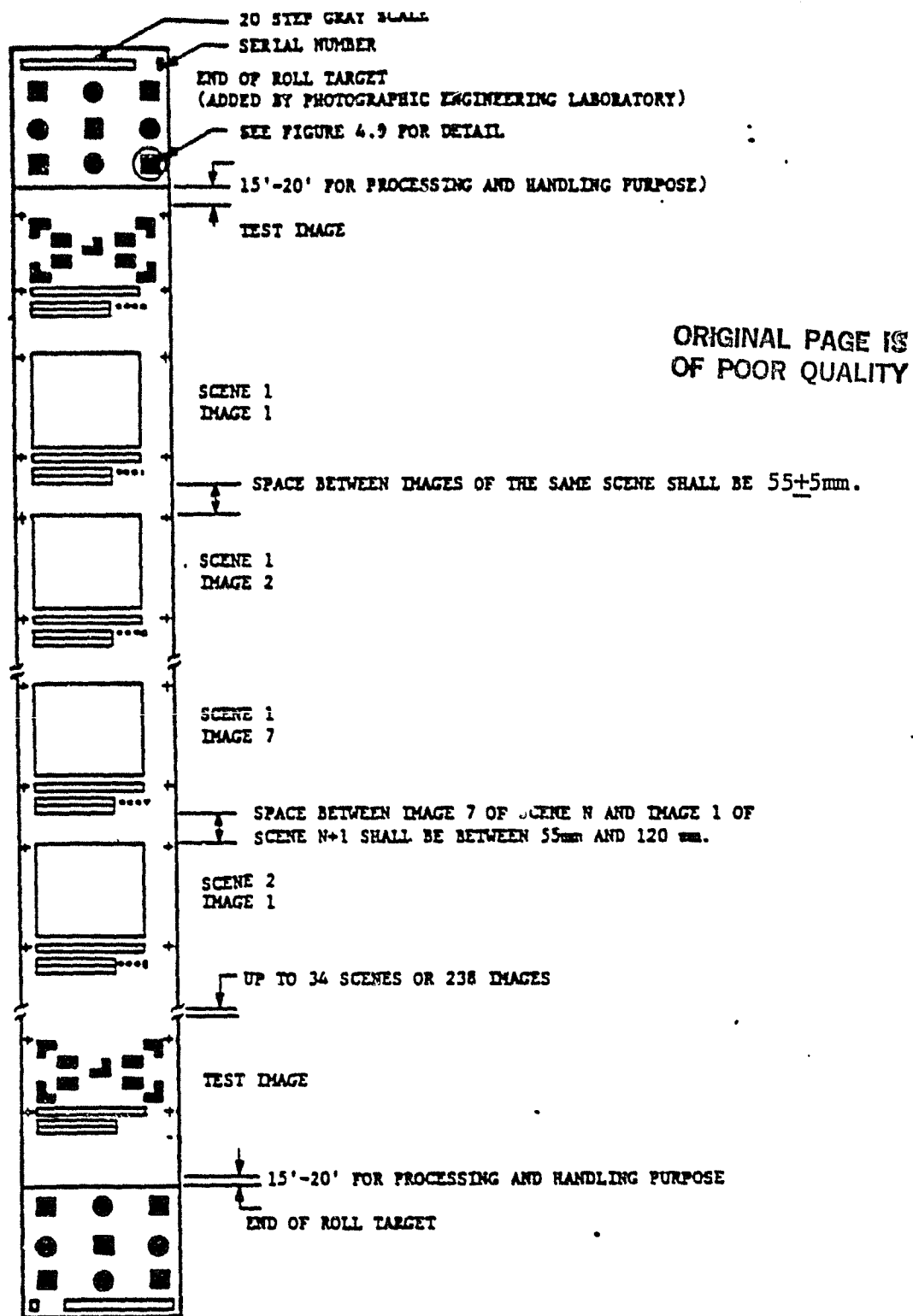
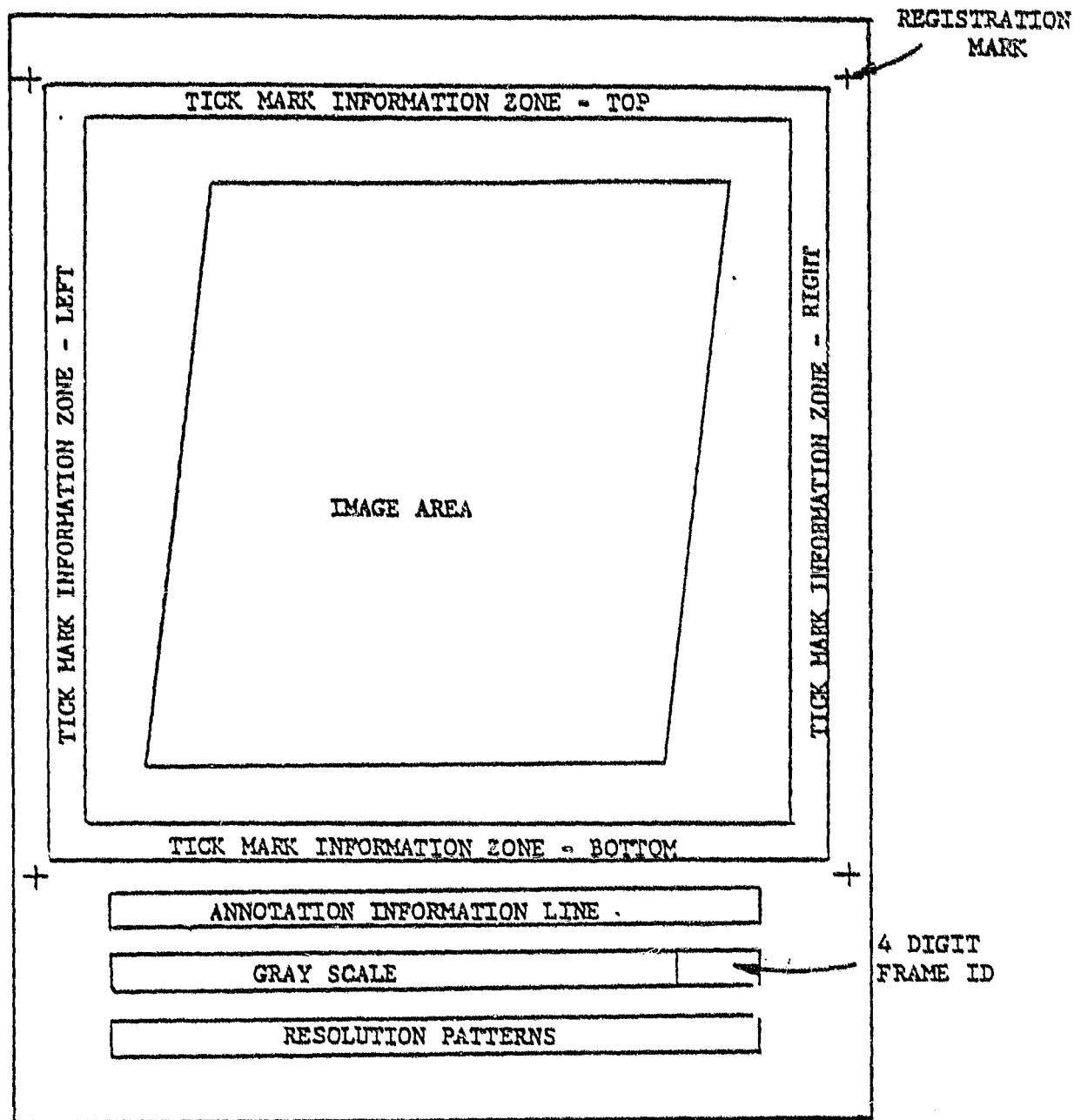


Figure 4-1. Film Format (Not to Scale)



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(NOT TO SCALE)

\* THE DATA SHALL APPEAR CLEAR AGAINST BLACK BACKGROUND.

Figure 4-2. Symbolic Representation of an Image on 24mm Film

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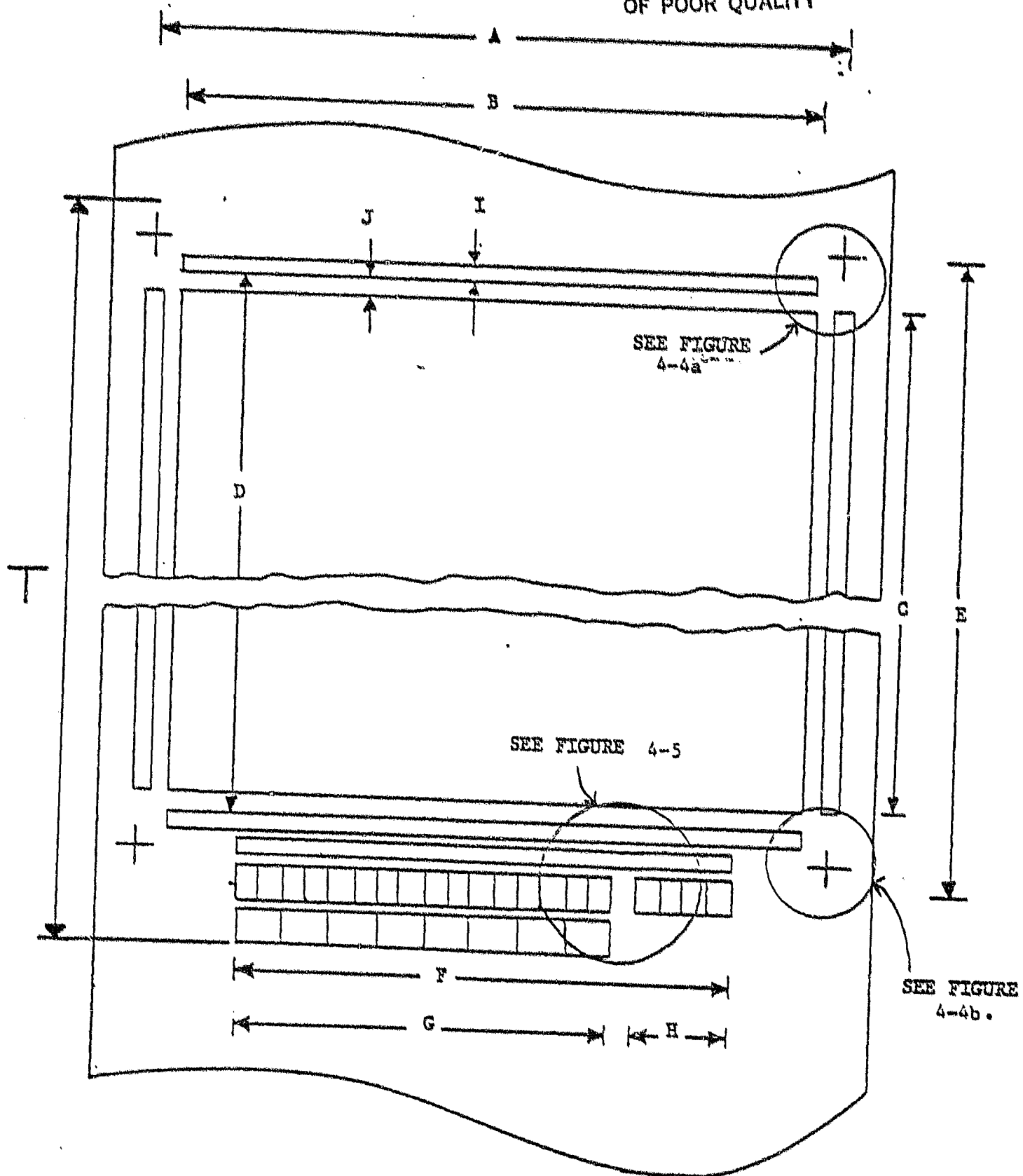
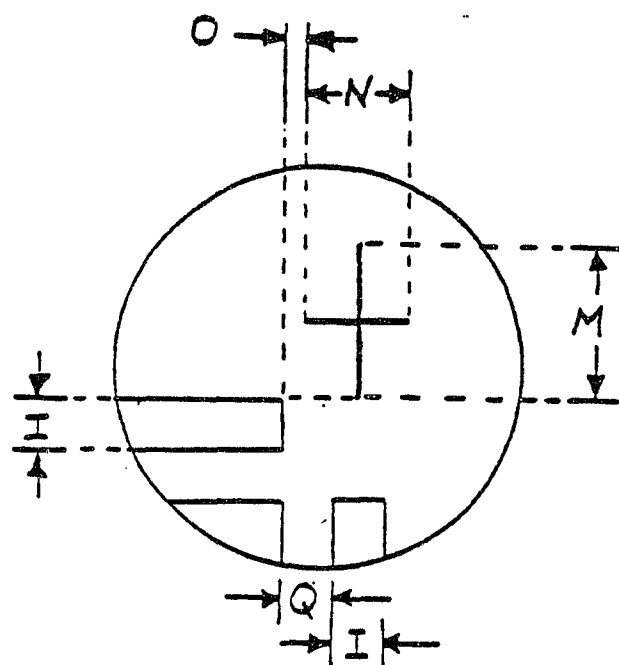
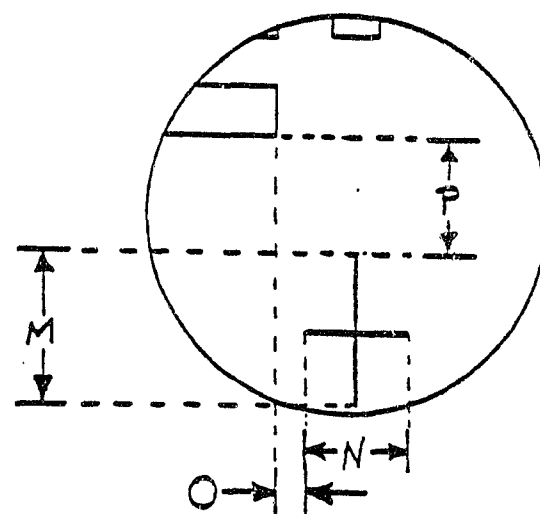


Figure 4-3. Image Dimensions

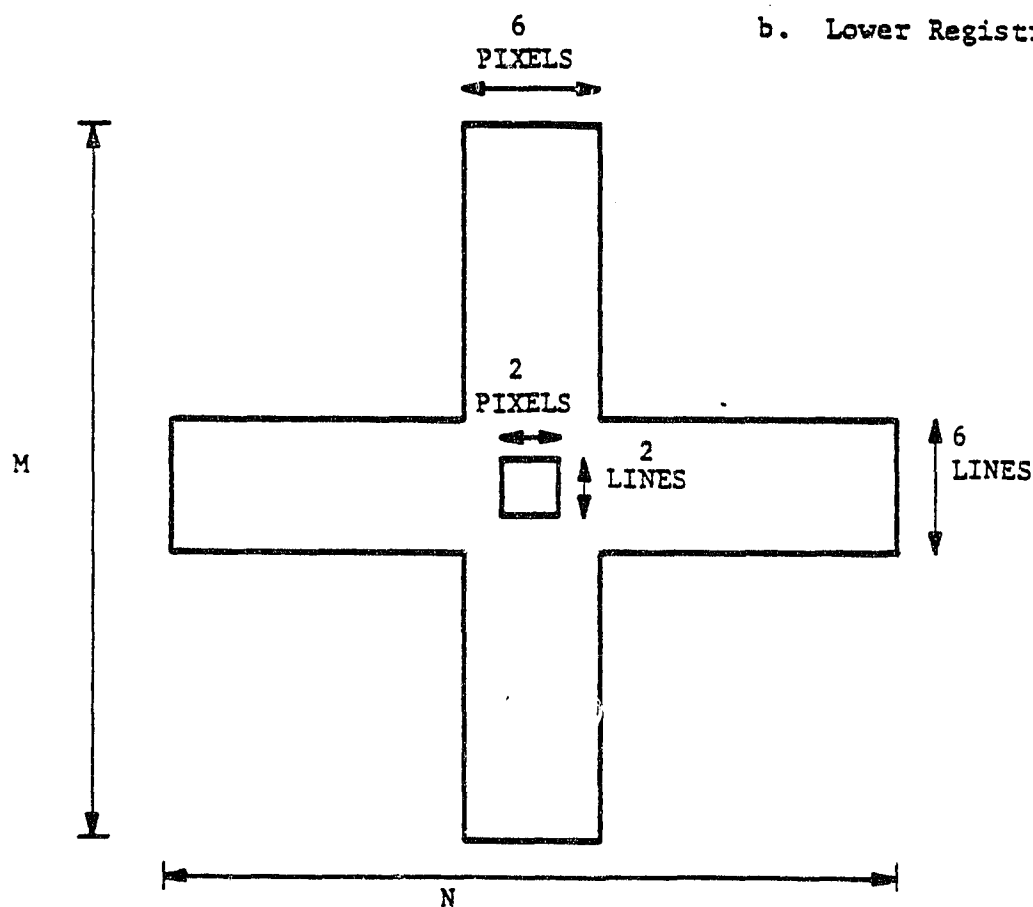


a. Upper Registration Marks

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b. Lower Registration Marks



c. Registration Mark Format

Figure 4-4. Registration Mark Dimensions

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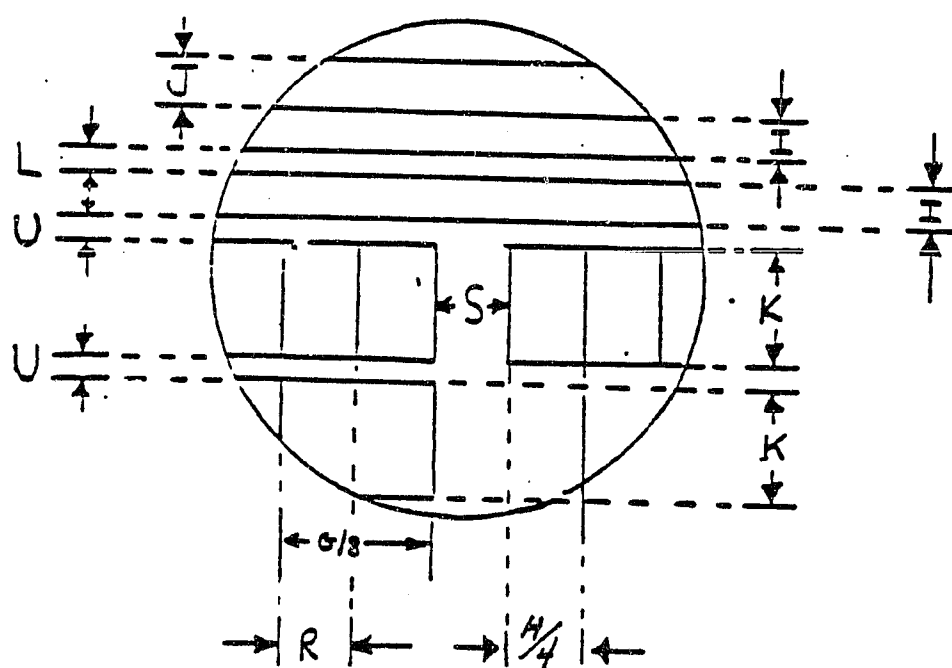


Figure 4-5. Annotation Area

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24 September

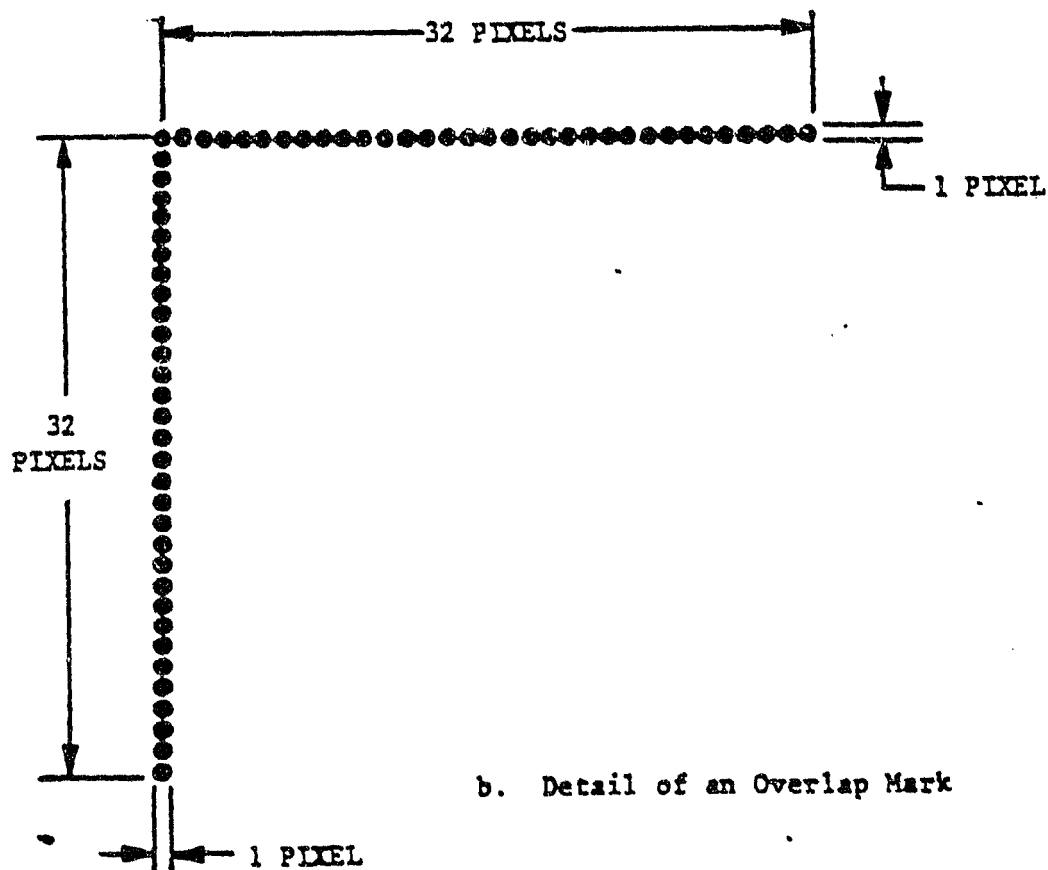
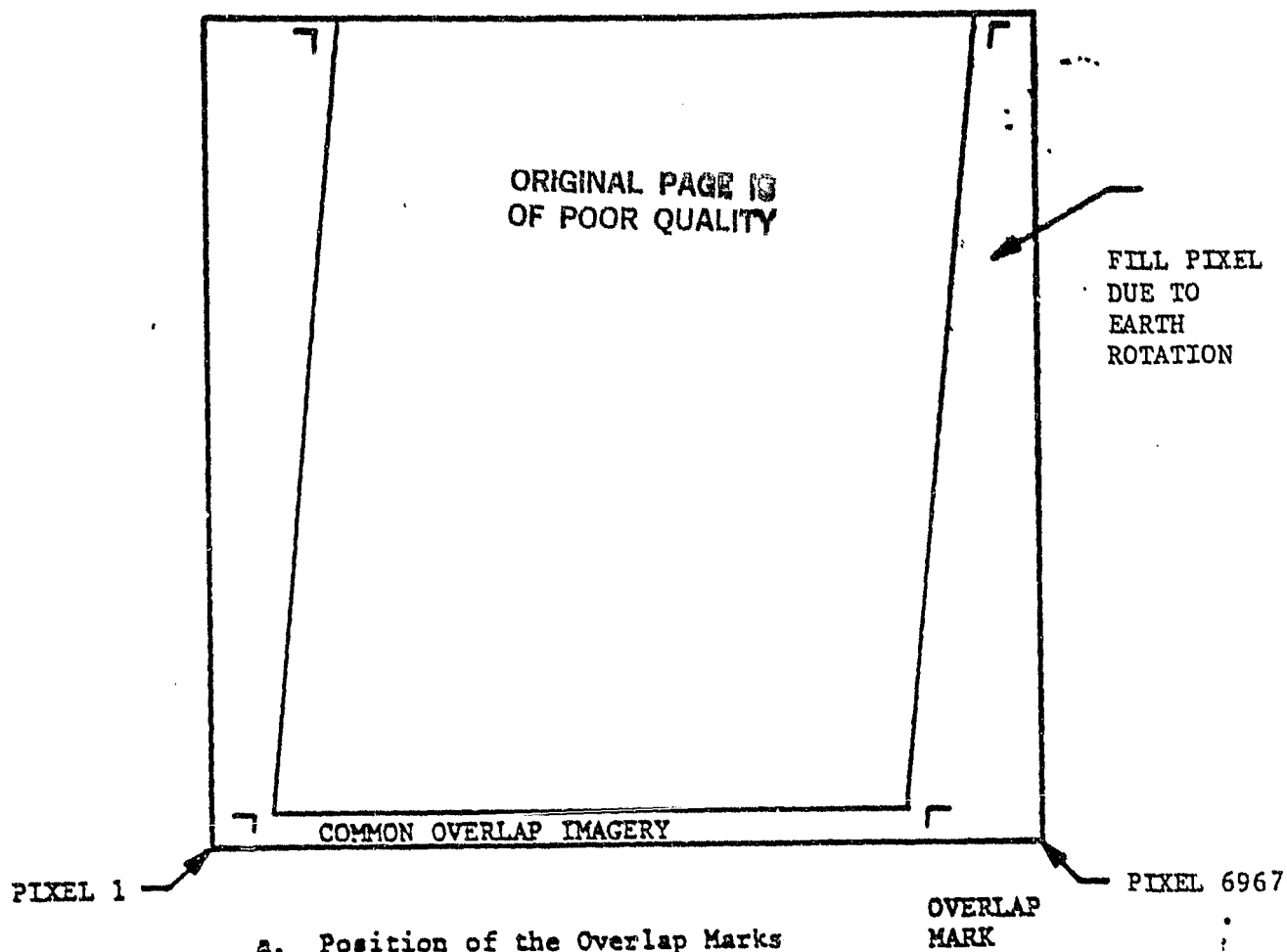


Figure 4-6. Overlap Mark

DATA FIELD	a	b	c	d	e	f	g	h	i	j		
CHARACTER POSITION	1-9	10-12	13-20	21-37	38-54	55-64	65-78	79-90	91-103	104-118	119-121	122-128
FIELD DESCRIPTION	WRS ROW AND PATH NUMBER	IMAGE ACQUISITION DATE	IMAGE FORMAT CENTER	WRS CENTER	BAND ID	SUN ANGLES	PROCESSING CODES	AGENCY AND PROJECTS	SCENE ID	BLACK	BOLL ID	
EXAMPLE	D202-101N											

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CM1133-03/W115-18N

IN1133-03/W115-42N

SURBEL 308A015

HASAWLABDSATN

8208201

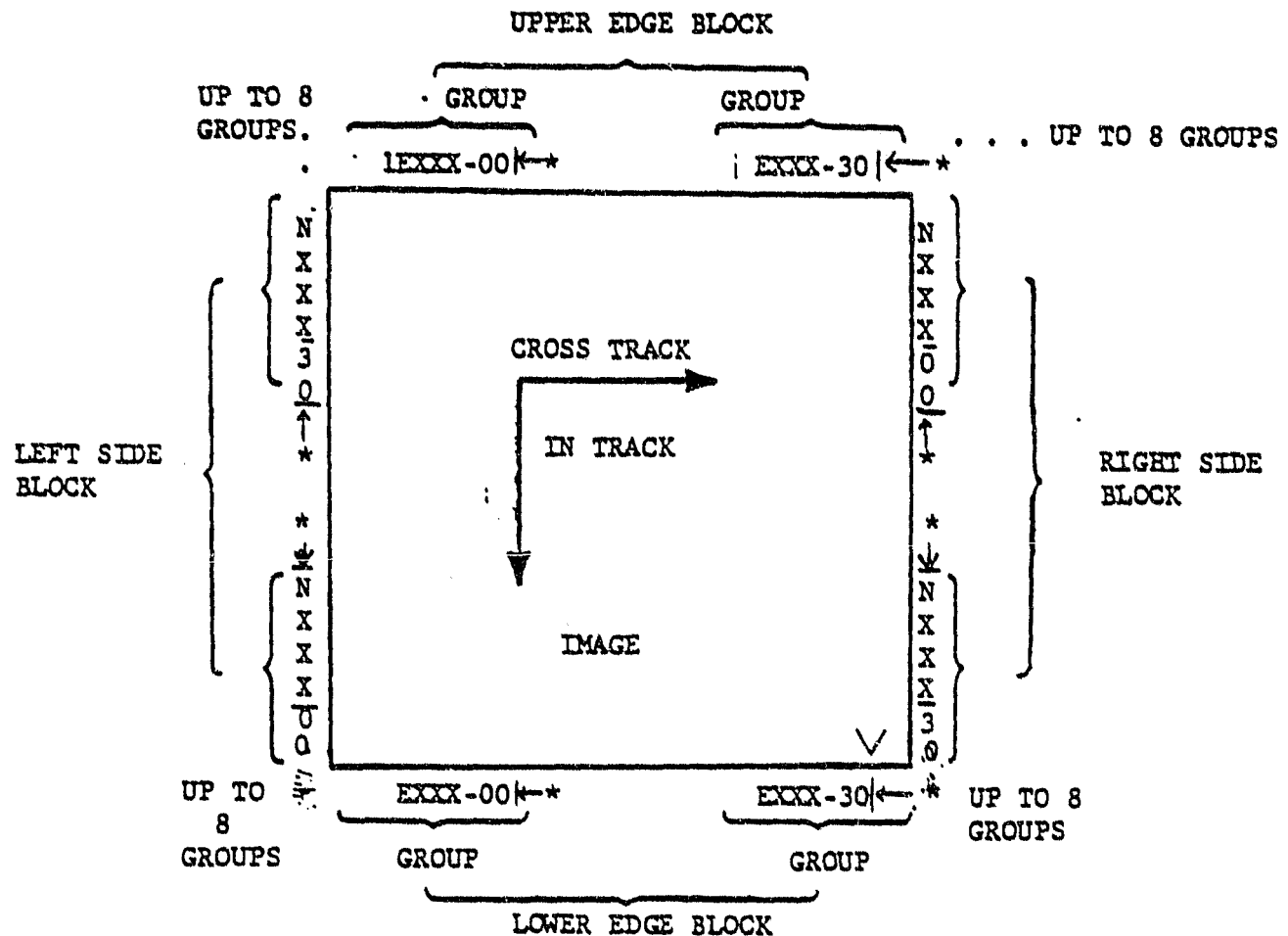
IMP-8D-RW12N

E41042-16032N

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Figure 4-7. Example of Annotation Field

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\* - ACTUAL TICK MARK; RIGHT OR BOTTOM JUSTIFIED UNLESS CROWDING OCCURS.

NOTE: / FOUR BLOCKS, WITH EACH BLOCK CONTAINING UP TO EIGHT GROUPS OF TICK INFORMATION.

Figure 4-8. Tick Mark Placement on Image

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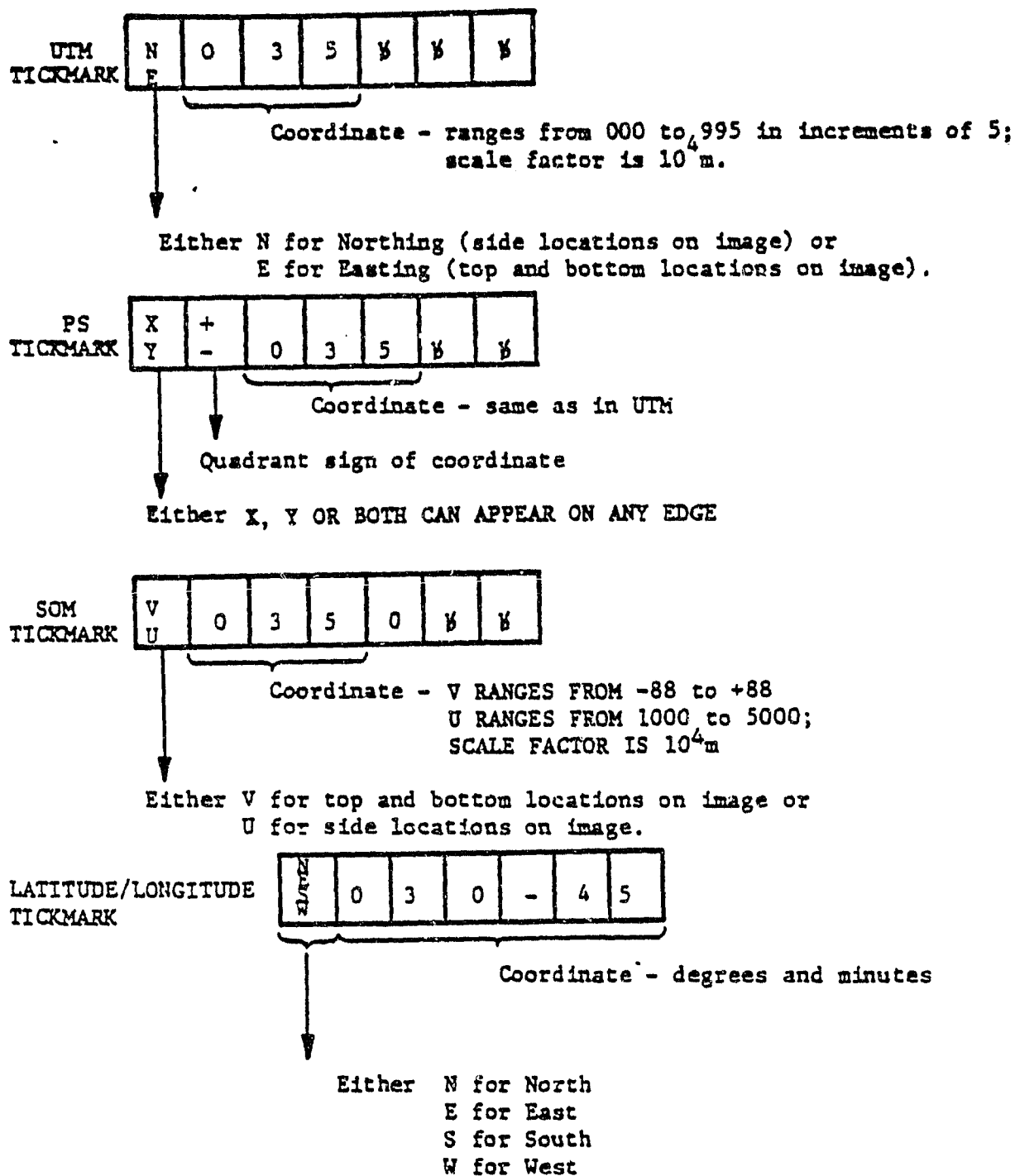
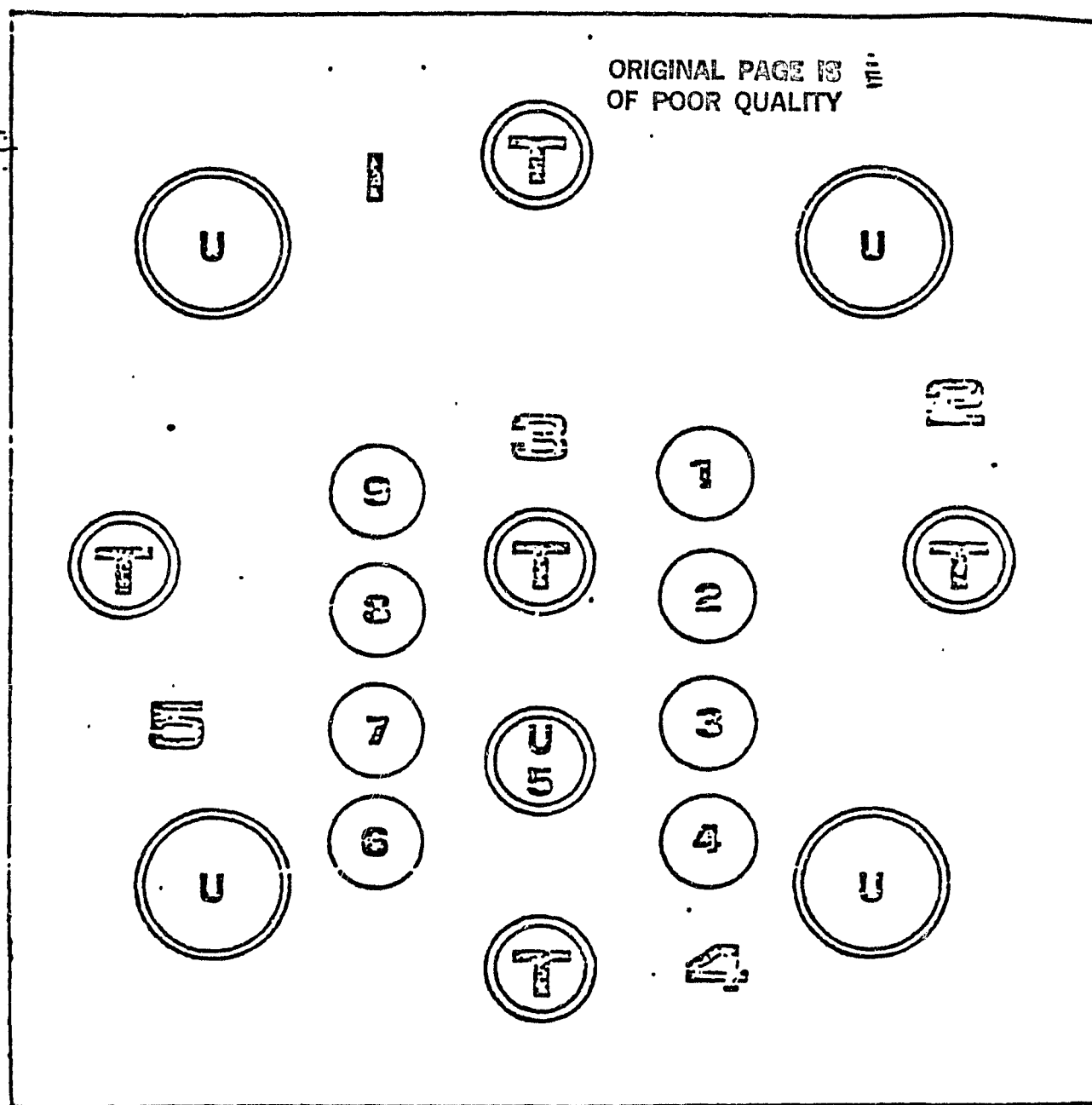


Figure 4-9. Tick Mark Annotation Formats



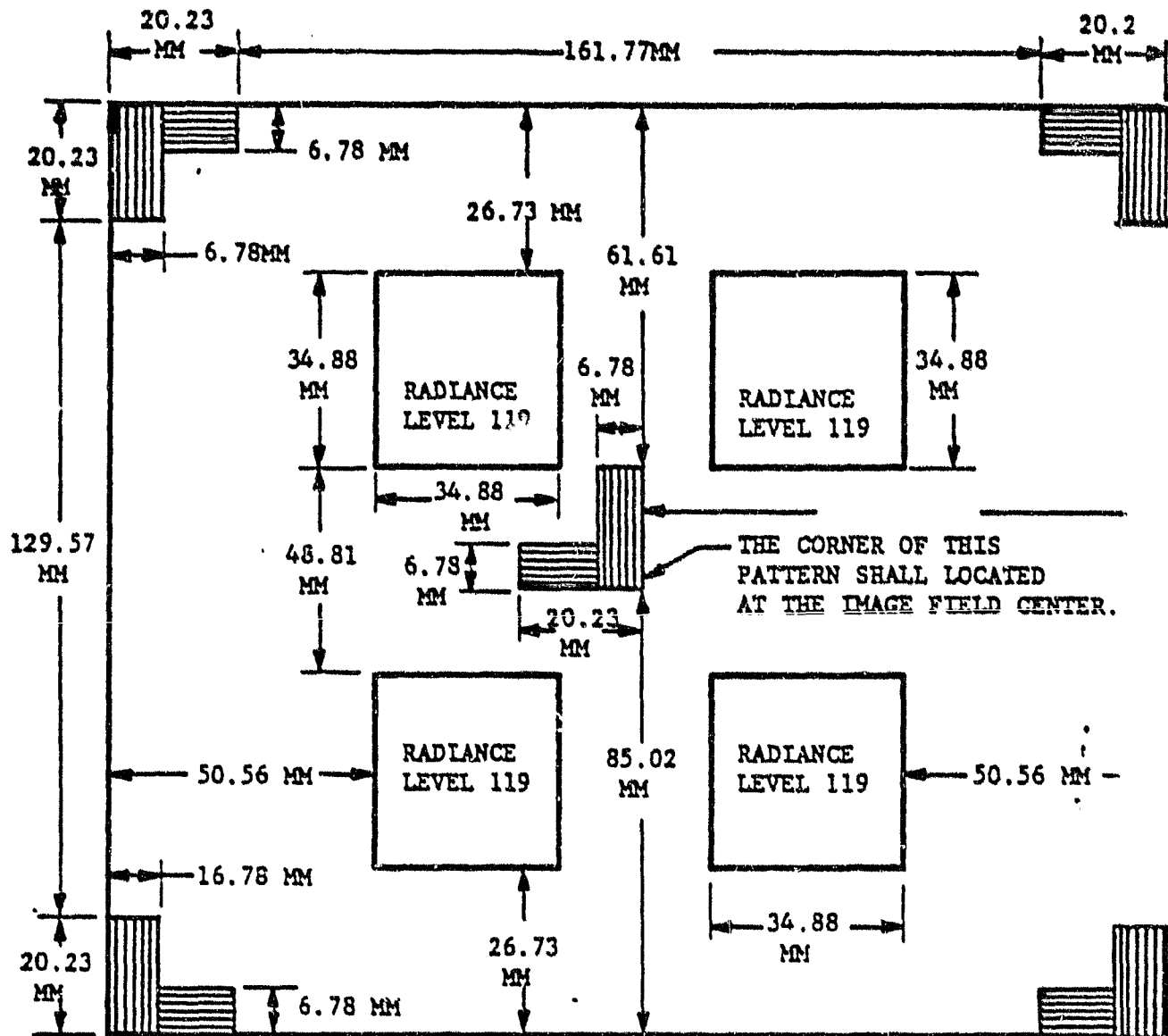
# 9 SPOT EORT



- 1-9 = Density Targets
- U = Uniformity Targets
- T = Resolution Targets

Figure 4-10. End-of-Roll Target Insert  
(Reference from Figure 4-1)

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THE 4 IDENTICAL CORNER PATTERNS AND THE CENTER PATTERN SHALL BE CONSTRUCTED BY USING ALTERNATING MINIMUM AND MAXIMUM INTENSITY, LEVELS.

THE 4 IDENTICAL CENTER SQUARES SHALL BE ONE UNIFORM LEVEL.

Figure 4-11. Test Image Format (Not to Scale)

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SECTION 5

TABLES

This section contains all the tables referenced in this document.

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Table 5-2. Detailed Explanation of the 128-Character Annotation Field

DATA* FIELD	CHARACTER POSITION	EXAMPLE*	EXPLANATION
a	1-9	D202-101	WRS path and row identifier, and orbital direction indicator. The 202 is path number and 101 is row number. "D" = descending node "A" = ascending node
	10-12		Blank
b	13-20	07Jun83	Day, month and year of image acquisition
c	21-37	CN33-05/W115-18	Image Format center - latitude and longitude of the center of the TM image format in degrees and minutes.
d	38-54	NN33-03/W115-42	WRS center latitude and longitude.
e	55-64	T1234567	Sensor and spectral band identification code. There are separate characters for each band: presence of a number indicates presence of that band, blank field indicates absence of that band. In this example, all bands are present.
f	65-78	SUNEL30A015	Sun Angles - the sun elevation angle and sun azimuth angle measured clock-wise from true north at the midpoint of TM frame is specified to the nearest degree. Blank for ascending node coverage.
g	79-90	UFP-D-NL2	PROCESSING CODES (These codes apply to the geometric correction matrix values and to the final geometrically corrected image data.) Character position 76 defines the type of geometric correction applied to the data: "U" = uncorrected "S" = system level corrected "G" = geometrically corrected based on geodetic information (no temporal registration performed) "T" = temporal registration using geodetic information from a single reference scene "R" = temporal registration to a single reference scene (no geodetic information available)
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Table 5-2. Detailed Explanation of the 128-Character Annotation Field (Continued)

DATA* FIELD	CHARACTER POSITION	EXAMPLE*	EXPLANATION
	81		Character position 78 defines the projection:  "P" = Polar Stereographic projection "S" = Space Oblique Mercator projection "U" = Universal Transverse Mercator projection "Ø" = geometrically uncorrected data
	83		Character position 80 indicates the resampling algorithm: "C" = cubic convolution "N" = nearest neighbor "Ø" = geometrically uncorrected data
	84		Character position 81 indicates the type of ephemeris data used to compute the image center: "P" = predictive "G" = GPS "D" = definitive
	86		Character position 83 gives the processing procedure: "N" = normal processing procedure. "A" = abnormal processing procedure. (defined as any processing procedure other than the normal procedure)
h	91-103	NASAØLANDSATØ	Identifies the agency and the project
i	104-118	E-41042-16032-6	Scene identification number--each image or frame will have a unique identifier which will contain encoded information consisting primarily of time of acquisition (universal time) relative to launch. Its format is E-NDDDD-HHMMSS-B and is interpreted as follows:

Table 5-2. Detailed Explanation of the 128-Character Annotation Field (Continu

DATA* FIELD	CHARACTER POSITION	EXAMPLE*	EXPLANATION
j	104	8208201	"E" = Encoded Project Identifier
	106		"N" = Landsat Mission Number
	107-110		DDDD = Day number, relative to launch, at time of observation
	112-113		HH = Hour at time of observation
	114-115		MM = Minute at time of observation
	116		S = Tens of seconds at time of observation
	118		B = Band identification code.
	119-121		Blank
	122-128		Roll Identification Number:
	122-123		Last two digits of year
	124-126		Day of year (001-366
	127-128		Sequence Number within day.
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Table 5-3. Digital Values and Density Levels for the 16 Gray Scale Steps

STEP NUMBER	EQUIVALENT TM LEVEL	DENSITY LEVEL*
1	0	2.1
2	17	1.2
3	34	.95
4	51	.79
5	68	.67
6	85	.57
7	102	.50
8	119	.43
9	136	.37
10	153	.32
11	170	.28
12	187	.24
13	204	.20
14	221	.17
15	238	.13
16	255	.10

\* Tolerance for each density level shall be  $\pm 0.05$ .

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Table 5-4. Film Roll Identification Format

CHARACTER	EXAMPLE	EXPLANATION
1-10	8	blank
11-36	FILM ROLL IDENTIFICATION88	The contents of this field shall always be as it appears in the example
37	L	Mission Initial, "L" = Landsat
38	4	Mission Number
39	T	Sensor Type, "T" = TM
40-41	LR	Product Type, "LR" = 241mm film Landsat-D Laser Beam Recorder Film Roll
42-43	82	Last two digits of year
44-46	082	Day of year (001-366)
47-48	01	Sequence Number within day, i.e 01 means first roll of the day
49-128	b	blank



SECTION 6

ACRONYMS, ABBREVIATIONS, SYMBOLS AND TERMS

Band	A collection of pixels representing a spectral portion of a scene
DMS	Data Management System
EDC	EROS Data Center
F241-PT	241mm film image of HDT-PT data
GSFC	Goddard Space Flight Center
HDT-P	High density digital tape containing radiometrically and geometrically corrected images
Image	A segment of Landsat-D data which corresponds to a $185 \times 170 \text{ km}^2$ Ground Segment in a particular spectral band
Landsat-D	Land Satellite (formerly ERTS)
Landsat-4	Post-launch designator for Landsat-D
LBR	Laser Beam Recorder
Line	A cross track motion of an active detector (a full scene width)
Pixel	One image detector sample
PS	Polar Stereographic
Scene	A segment of Landsat image data which corresponds to a $185 \times 170 \text{ km}^2$ ground area
SOM	Space Oblique Mercator
Tick Marks	Positional marks placed on imagery to enable a location grid coordinate system to be constructed
TM	Thematic Mapper
UTM	Universal Transverse Mercator

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